Risk factors for injury in talented soccer and tennis players

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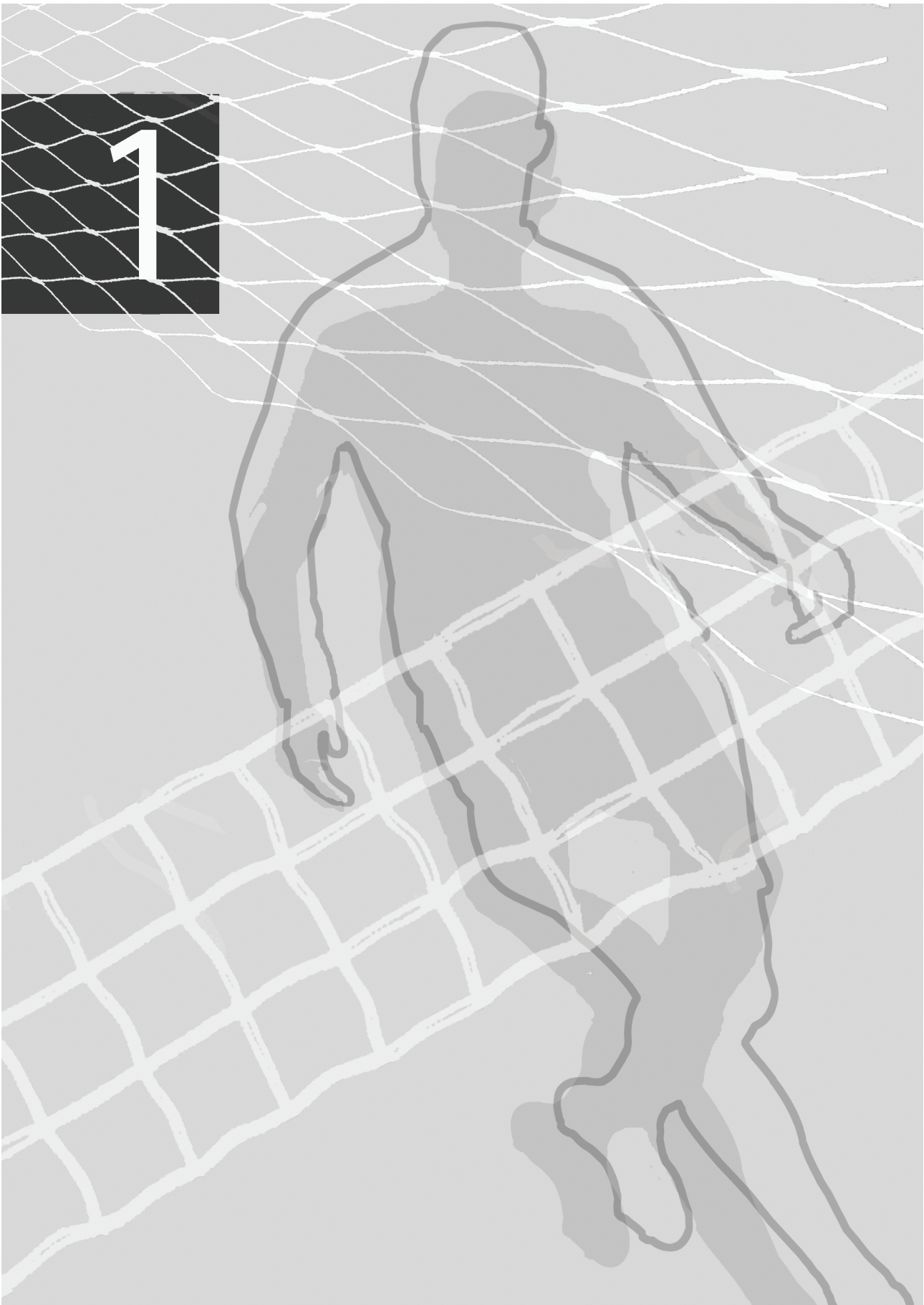

CHAPTER 1

GENERAL INTRODUCTION

BACKGROUND

In talented athletes, injuries account for a considerable amount of time loss from training and competition [8, 29]. Although literature shows that the nature and incidence of injuries vary for different sports, the problem is substantial overall. In talented soccer players injury rates of 5.6 injuries per 1000 hours of exposure and 37.6 injuries per 1000 match hours have been found, including both traumatic and overuse injuries. Between 10% and 40% of these injuries can be classified as overuse injuries [3, 10, 19]. In talented tennis players, injury rates of between 2.3 injuries per 1000 hours of exposure and 21.5 per 1000 injuries athletic exposures have been mentioned in literature. The proportion of overuse injuries is higher compared to soccer players: between 47% and 55% of the injuries can be classified as overuse injuries [16, 18, 28]. Since there is only restricted time available for talented athletes to reach the elite level, optimal performance development is crucial and injuries will hinder this performance progress. Also, severe injuries can result in negative long-term health consequences [8, 31]. Therefore, injury prevention in the target group of talented athletes, such as soccer and tennis players, is of utmost importance.

MATURATION

In talent development programs, substantial increments in volume and intensity of training and matches take place during the pubertal years, resulting in a higher load placed on the developing adolescent bodies [9, 27, 30]. These increments in load overlap a period in which all talented athletes experience progress towards maturity or towards their biologically mature state [1, 25]. Maturation is the driving force for many processes, such as the adolescent growth spurt, the development of secondary sex characteristics, and behind development of the brain, leading to many emotional and behavioral changes that make adolescents explore adult behavior [1, 33]. Maturation is a process that should be viewed in two concepts: tempo and timing. Tempo refers to the rate at which maturation progresses, e.g. how quickly or slowly a youngster passes through the adolescent growth spurt. Timing refers to when specific maturational events occur, e.g. the age at the beginning of the development of secondary sex characteristics, or the age at the

beginning of the adolescent growth spurt. It has been suggested that the combination of these maturation-driven processes, and a high training and match load in the same period, could increase the risk on both traumatic and overuse injuries in talented athletes [4, 8, 14, 25, 27].

THE ADOLESCENT GROWTH SPURT

By the time girls are 9 to 10 years and boys 11 to 12 years old, their rate of growth begins to increase, until it reaches a peak around age 12 in girls and age 14 in boys. During this adolescent growth spurt (often referred to as Peak Height Velocity (PHV), girls gain on average 9 cm, and boys 11 cm in height per year [26]. The growth rates of different tissues, such as bone tissue, muscle tissue and tendon tissue differ [21]. These different growth rates result in several injury risk factors, such as increased tightness and inflexibility around joints and decreased neuromuscular control [13,15]. Also, growth cartilage seems more vulnerable to high training and match loads during periods of growth, and the same accounts for bone tissue, leading to skeletal fragility and increased fracture incidence during the adolescent growth spurt [4, 11]. However, knowledge on the influence of tempo of growth and at what moments around their Peak Height Velocity athletes are especially vulnerable, is currently lacking.

Besides the influence of tempo of the growth, the timing of the adolescent growth spurt has long been discussed as a potential risk factor for injuries. Due to differences between athletes in timing of biological maturation, there is considerable variation in size, power, speed and agility of talented athletes, mostly in favour of earlier maturing players [12, 17]. Although some studies have examined differences in training and match injury incidence in talented players with different timing of PHV, none have done this prospectively.

ADOLESCENT RISK-TAKING

In addition to the above mentioned dramatical physical changes, maturation also has a profound effect on structural and functional

brain development. Basic cognitive control functions such as inhibition, task-switching and working-memory are not fully mature until young adulthood and might even show a decrease in performance on these functions in early adolescence [7, 23]. The use of complex cognitive control functions (metacognitive skills, used to solve problems and to progress towards a goal) gradually increases. Brain systems responsible for motivation of behavior, such as reward and emotional systems, are more active during adolescence, and start to have more influence on the use of cognitive control functions. As a result, adolescents are more sensitive from rewards from the social domain. Especially acceptance of the peer-group becomes more important. Also, increases in sensation-seeking and novelty-seeking are seen, and adolescents have more intense emotional experiences [7].

The above mentioned changes lead to increased risk-taking behavior that is potentially damaging the health of adolescents. For instance, taking bold actions in the presence of peers, reckless traffic behavior, but also gambling, alcohol and tobacco use, and excessive gaming or internet use [24, 33, 34]. Risk-taking mainly takes place in situations that are important for the adolescent and occurs often in social situations with peers. The elite sport context is a major peer group for adolescent athletes: they spend an enormous amount of time focusing on sport and its intertwined social domain, at the exclusion of almost everything else. Several authors have described the sport context as a 'culture of risk' in which athletes willingly accept or ignore risks of pain and injury [32]. The combination of the risk-culture in which talented athletes move and the cognitive maturational processes that take place within them, could lead to increased risk-taking behavior, resulting in vulnerability for injuries. However, as far as the authors know, there is no research that has investigated this relationship.

METACOGNITIVE SKILLS

As mentioned above, the use of metacognitive skills increases during adolescence. It is known that talented athletes use metacognitive skills such as reflection, planning, monitoring, and evaluation, to constantly improve their performance in their road to success [20]. We also know that adult athletes are actively engaged in trying to manage the

threats of injuries [29, 35]. They speak of this as a learning process, whereby they become to understand their bodies' capacities and limits and how to respond to them. There are indications that metacognitive skills might not only be of use in performance progress, but also in regulating one's health and preventing oneself from becoming injured [2, 6]. Knowledge on the role of metacognition in relation to injuries can give coaches and athletes increased understanding on how they can be used in prevention, while striving for expert performance.

THESIS OUTLINE AND RESEARCH QUESTIONS

This thesis sheds light on the role of maturation-driven processes in the occurrence of injuries in talented soccer and tennis players. Yet unanswered questions in literature are identified and studied, such as: what is the influence of the adolescent growth spurt on injury risks in talented athletes? Is this relationship different for traumatic than for overuse injuries? What is the relationship between risk-taking during adolescence and occurrence of injuries? And what is the role of metacognitive skills in the occurrence of injuries?

The main goal of this thesis is to identify risk factors for injuries in talented adolescent athletes, specifically related to maturation-driven processes that are typical for this target group. More knowledge on those aspects can help to develop prevention strategies for injuries.

In **Chapter 2** we will look at the role of the adolescent growth spurt in the occurrence of injuries in talented soccer players, by identifying differences in traumatic and overuse injuries in the year before, the year of and the year after Peak Height Velocity. In **Chapter 3**, we focus on the influence of tempo of physical maturation (measured as changes in height, BMI and fat free mass) on the occurrence of injuries. This is done by frequent anthropometric measurement and registration of injuries in a cohort of 101 talented soccer players. In **Chapter 4** we focus on the influence of timing of the adolescent growth spurt, by identifying differences in injury occurrence between earlier and later maturing soccer players. In **Chapter 5** we investigate the relationship between risk-taking and overuse injuries in a population of talented tennis players. 73 talented male and female tennis players were

followed during one season. In **Chapter 6** we will look on the possible protective role of metacognitive skills for having overuse injuries, in a group of talented tennis players. This thesis ends with **Chapter 7**, discussing the relevant outcomes of the studies, recommendations for future research and practical implications.

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